IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF APPEALS

In re Application of

Amit Sarkhel et al

SERIAL NO: 09/~~772,278~~ 771,240 EXAMINER: SIKYIN, IP

FILED: January 26, 2001 : GROUP: 1742

FOR: LEAD FREE, HIGH TIN TERNARY SOLDER ALLOY OF TIN, SILVER AND BISMUTH

BRIEF FOR APPELLANT

Commissioner for Patents
United States Patent and Trademark Office
P. O. Box 1450
Alexandria, VA 22313-1450

SIR:

All necessary fees in connection with this Appeal Brief should be deducted from Deposit Account No. **01-1944**.

(1) **Real Party In Interest**:

International Business Machines Corp. as appellant, is the real party in interest.

(2) **Related Appeals and Interferences**:

There is no related appeal or interference proceeding.

(3) **Status of Claims**:

Claims 9, 10, 13 and 14 are pending in the application. The Claims are set forth in the Appendix attached hereto and made a part hereof.

(4) **Status of Amendments Filed Subsequent to Final Rejection:**

In the advisory action, Paper No. 9, paragraph 3, the Examiner stipulated that applicants amendment dated March 14, 2003, filed subsequent to the final rejection and upon which this appeal is based will be entered upon the filing of the Notice Of Appeal and upon it being made of record.

(5) **Summary Of Invention**

This application constitutes a division of US patent application 09/216042, now abandoned, and relates to a method of joining at least two microelectronic components to one another by connecting the components with a ternary solder alloy consisting essentially of from about 70 to less than 91 wt % tin, between 6 to about 15 wt % bismuth and 2 to 5wt % silver. The application also relates to a process for producing circuit boards in which a stationary wave of liquid solder as above defined is produced and with a circuit board moved across the wave with the circuit board in contact with the wave of liquid solder.

The method and process of the present invention uses a ternary Sn-Ag-Bi solder alloy system resulting in the formation of high content ternary eutectic phases in the microstructure of the a soldered joint. Moreover, the soldered joint has high ductility, high strength and good thermal fatigue resistance relative to that of the standard lead-tin solders and having a melting temperature very close to the melting temperature of the standard lead-tin solder.

Solder alloys which are eutectic are commonly used in electronic fabrication to form an intermetallic joint. The composition of the alloy and quench rate determine the microstructure and the resulting properties of the joint. It is well known to those skilled in the art that even a slight variation in concentration of one or more of the elements of the composition will alter the eutectic point and change the liquidus temperature as well as the properties of the microstructure. Moreover the change in properties in a solder alloy is not easily foreseeable and the properties cannot be predicted by comparison with similarly known binary or even ternary compositions. This is one reason why this is now a very crowded art as is reflected in the multiple number of issued patents covering different electronic solder alloy compositions and methods of use in which the principal distinction is a variation in the concentration range of one or more of the elements in the solder.

In the method of claim 9 and the process of claims 13 and 14 a ternary Sn-Ag-Bi solder alloy composition is used consisting essentially of from about 70 to less than 91 wt % tin, between 6 to about 15 wt % bismuth and from 2 to 5wt % silver. The result of this method is an advantageous microstructure which as explained above provides a melting point in close coincidence to that of conventional tin/lead alloy solders and a soldered joint of high ductility and high strength while possessing good thermal fatigue resistance relative to that of the standard lead-tin solder. Simply stated, the method of the present invention results in joining at least two microelectronic components to form a microstructure equivalent to or better than obtained using a conventional binary tin-lead solder and having approximately the same melting pointtemperature. The conventional tin-lead eutectic solder consists of

63Sn/37Pb and has a melting point of 183° C whereas the melting point of the Sn-Ag-Bi alloy composition used in the subject invention and as claimed in claims 9, 13 and 14 falls into a limited range of between 190-200°C. This is supported in the specification in the last paragraph of page 15 and first paragraph of page 16. It should be noted that most electronic materials cannot safely be joined and withstand reflow soldering when the solder melting point exceeds above about 210°C.

(6) **Concise Statement Of Issues**

1. Claims 9, 10, 13 and 14 stand rejected under the judicially created doctrine of obviousness-type double patenting over claims 12-17 of US Patent No. 5730932 to Sarkhel. Applicant has stipulated, and continues to stipulate, that upon an indication of allowable subject matter a Terminal Disclaimer will be filed with requisite fee to overcome this rejection.

2. Claims 9, 13 and 14 also stand finally rejected under 35USC 103(a) as being unpatentable over US Patent No. 5439639 to Vianco in view of USP Re. 33197 to Deambrosio, USP Re. 32982 to O'Rourke or US Patent 5361969 to Gileta.

3. Claim 10 separately stands finally rejected under 35USC 103(a) as being unpatentable over the same references applied to claims 9, 13 and 14 and further in view of Kattner et al.

(7) **Grouping Of Claims**

Claims 9 and 13 and 14 have been grouped together and rejected as one. However claims 9, 13-14 are all independent claims and claim 14 includes a

specific liquidus temperature limitation not in claim 9 or claim 13. Accordingly, the allowance of claims 9, 13 should be treated separately from claim 14 and should not stand or fall together.

Claim 10 depends from claim 9 but has been rejected separately from the rejection of claim 9. The rejection of claim 10 is based upon an additional teaching of yet a further reference as set forth above in paragraph 3. Accordingly, claim 10 clearly does not stand or fall as part of the rejected grouping of claims 9 and 13-14.

(8) **Argument**

The final rejection is under 35USC103 alleging obviousness based primarily upon the teaching of US Patent No. 5439639 to Vianco. More specifically the Examiner alleges that Vianco '639 at col. 5 line 39 discloses in table 1 an alloy composition of 90.48 wt% tin, 5.28 wt% Ag and 6.23wt% Bi and asserts that this composition anticipates the alloy composition specified in each of the claims 9, 13 and 14. The Examiner further argues that the only difference between the claimed subject matter and the cited reference Vianco '639 is a higher Bi content and that it would be obvious to select a range within an otherwise known range for purposes of optimization to achieve best results.

It was pointed out to the Examiner that the last alloy composition of table 1 in column 5 of Vianco indeed contains 90.48 wt% tin, 5.28 wt% Ag and 6.23wt% Bi but does ***not*** anticipate the alloy composition specified in claims 9, 13 and 14 in that the content of silver in the subject application, as presently claimed, must be no more than 5wt% silver and, as such, a rejection based upon anticipation is

misplaced. Moreover since the rejection of the claims is under 35USC 103 and not 35USC102 the use of the term "anticipation" which connotes lack of novelty, is misleading and inappropriate to a rejection under 35USC103. More to the point, not only is the content of silver too high as regards the specific alloy composition referred to by the Examiner but the content of bismuth is otherwise limited in Vianco to a maximum content of 5wt%, i.e., with the exception of the last alloy composition at the bottom of table 1 in which bismuth is 6.23 wt%. Stated otherwise, not only are all of the other recited ternary alloys in table 1 of Vianco limited to well below 5wt% Bi but Vianco throughout the specification specifically teaches a maximum concentration of bismuth of no more than 5wt%. This is taught in Vianco in column 7 lines 20-24 and in column 4 lines 41-50 with the latter providing a supporting explanation for limiting Bi to no more than 5wt%.

Furthermore, in the paragraph below Table 1of Vianco, i.e., column 5, lines 40-45, specific reference is directed to the characteristics of the last alloy in table 1 stating that "The last alloy with 6.23Bi showed a second peak ....at 136.8°C indicating that the Sn phase has been saturated with Bi, causing the formation of 58Bi-42Sn within the solder". This is consistent with the explanation of Vianco in column 4 lines 41-50 for rejecting any composition having a concentration of bismuth greater than 5wt% so that "bismuth will remain in solution with tin to effect a melting point depression without low temperature phase precipitation" which is exactly what Vianco believes to have occurred with the last alloy composition in Table 1 and explains why Vianco considers this composition unacceptable and undesirable. Accordingly this is not simply a less preferred composition, as is suggested by the Examiner, but is in

essence an express teaching not to exceed 5wt% Bi with the last example in table 1 representing a rejected composition.

The Examiner has, but for the last example in table 1 of Vianco, ignored the remainder of the disclosure and has otherwise tried to explain away the maximum Bi teaching in Vianco by implying that this is only a preferred requirement and that the last alloy example in Table 1 is otherwise an example of a less preferred composition. To the contrary no support exists in Vianco to justify the naked allegation or assumptions of the Examiner and the motivation of the Examiner comes entirely from the teaching of the subject application. Moreover, not only is there no support in Vianco to justify the allegation but the allegation is, in fact, directly inconsistent and contrary to the teaching of Vianco.

Furthermore, the Examiner makes no attempt to explain or justify the allegation or to address the content of silver in the last alloy composition which falls outside the claimed alloy composition. The alloy composition claimed in claims 9, 13 and 14 requires both the concentration of bismuth to be above 6wt% and the concentration of silver to be kept below 5wt%. As regards the other cited references none teach the specific ternary alloy composition claimed in the subject application much less in the concentration range specified and do not teach a method for using the composition for producing a stationary wave solder or for joining at least two microelectronic components to provide a microstructure equivalent to or better than the microstructure obtained using a binary tin-lead solder and at approximately the same melting temperature of a binary tin-lead solder.

The conclusion of the Examiner that it would be obvious to adjust the concentration of Bi (and commensurately that of Ag) to fit the composition for use in the method claimed by applicant is motivated from the teaching of applicants specification. Without applicants specification no motivation has been shown to exist in any of the other cited references. The Examiner is simply alleging that it would be "obvious to try" to adjust the composition range to fit the composition claimed by applicant for the purpose of optimization in view of the similar composition in the rejected example in Vianco albeit the wording "obvious to try" has not been used.

In contrast to Vianco the Ti-Ag-Bi alloy composition of the subject invention requires the concentration of bismuth to be above 6wt% and the content of silver to be below 5wt% in order to stay within the shaded rectangle area JKLM as shown in Figure 5 and as explained in the specification on page 15 last paragraph to page 16 line 2. This is not taught in Vianco or any of the other cited references. In fact in the dependent claim 10 the range of bismuth, in the ternary alloy, is between 10-15wt%.

As taught in the MPEP section 2141.02 prior art must be considered in its entirety including disclosures that teach away from the claims, see W.L. Gore and Associates Inc. Garlock Inc. 220 USPQ 303 (Fed. Circ. 1983). As further taught in Gillette Co. v. S.C. Johnson & Sons Inc. 16 USPQ 2d 1923 (Fed Cir 1990) instead of suggesting obviousness the closest prior art reference " would likely discourage the art worker from attempting the substitution suggested by the inventor". This area of the law has been further reinforced in In Re Gurley, 31 USPQ 2d 1130, 1132 (Fed. Cir. 1994) where it is stated that: "....A reference may be said to teach away when a person of ordinary skill , upon reading the reference, will be discouraged from following

the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant...". Applicant considers the requirement spelled out by Vianco to constitute an express teaching away of Bi above a concentration of 5 wt % in a tenary composition of Sn, Bi and Ag. Moreover, no motivation has been shown to exist in any of the other cited references for adjusting Bi to above 5wt% while keeping the content of silver below 5wt%. In the present case the Vianco reference would clearly lead one skilled in the art in a direction divergent from the teaching of applicant. This is further supported in In re Nelson 2 USPQ2d (Fed. Cir. 1987) and in In re Fine 5 USPQ2d 1596 (Fed. Cir. 1988).

Moreover, claims 9, 13 and 14 are method claims and the Examiner admits that the wave soldering method as claimed in Claims 13 and 14 is not disclosed in Vianco. Moreover claim 14 is further limited by a specified liquidus temperature which the Examiner makes no reference to in the rejection other than to state that the method is taught in the other cited references and is therefore obvious to combine with Vianco.

Instead the Examiner maintains that "a reference is not limited to what the author describes as his invention" citing In re Heck 699 F2nd 1331 (Fed. Cir. 1983.) Applicant believes that the Examiner has misconstrued and misapplied the teaching in In re Heck and has, in effect, disavowed the entire doctrine requiring consideration of disclosures in a prior art reference which teach away from the claimed invention and that prior art must be considered in its entirety.

Applicant does not believe the Examiner has even made a bona fide attempt to justify the rejection of claim 10 which requires bismuth to be limited to 10 – 15 wt%.

(9) **Conclusion**

The Examiner has clearly failed to substantiate a prima facie rejection of claims 9, 10, 13 and 14 under 35 USC 103(a). Accordingly, Applicant respectfully solicits the Board of Patent Appeals to reverse the final rejection of claims 9, 10, 13 and 14 under 35 USC 103(a).

Respectfully submitted

Eugene Lieberstein
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MAILING CERTIFICATE

I hereby certify that this correspondence is being deposited with the U.S. Postal Service as first class mail in an envelope addressed: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on June 30, 2003.

Mary Mahoney

Date: June 30, 2003

APPENDIX

Claims:

9. A method of joining at least two microelectronic components to one another comprising the steps of connecting the components to be joined with a ternary solder alloy consisting essentially of from about 70 to less than 91 wt percent tin, between 6 to about to about 15 wt % bismuth and 2 to 5 wt % silver.

10. A method as defined in claim 9 wherein said solder alloy consists essentially of about 10-15 wt % bismuth, 3.3-3.5 wt % silver, balance tin.

13. A process for producing circuit boards, comprising the steps of:

producing plated through holes in a circuit board;

inserting the pins of pin-in-hope components into the plated through holes;

producing a stationary wave of liquid solder consisting essentially of from about 70 to less than 91 wt % tin, between 6 to about 15 wt% bismuth and from 2 to 5 wt% silver;

moving the circuit board across the wave with the bottom of the circuit board in contact with the wave, thereby substantially filling the plated through holes with solder;

cooling the circuit board to form solid solder joints.

14. A process for producing circuit boards comprising the steps of:

producing a substrate with multiple wiring layers including exposed metal pads on a surface;

forming a solder paste comprising a flux, an organic vehicle and particles of metal consisting essentially of from about 70 to less than 91 wt % tin, bismuth in excess of 6 wt% and up to about 15 wt% and from 2 to 5 wt% silver;

depositing the solder past upon said substrate;

placing terminals of a surface mount component onto corresponding pads of the substrate;

heating said solder paste to a temperature above the liquidous temperature of the solder paste sufficient to reflow the solder paste to connect the substrate; and

cooling to solidify the connections.